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Application of:

Tsai, et al.

Serial No.: 09/961,134

Confirmation No.: 4110

Filed: September 21, 2001

For: Method and Apparatus For
Forming Metal Layers

MAIL STOP AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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Group Art Unit: 1753

Examiner: Wong, Edna

**CERTIFICATE OF MAILING**  
**37 CFR 1.8**

I hereby certify that this correspondence is being deposited on April 20, 2004, with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

4/20/04

Date \_\_\_\_\_

Kunt & Zuber

Signature \_\_\_\_\_

Dear Sir:

### DECLARATION UNDER 37 C.F.R. § 1.131

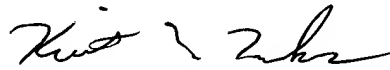
I, the undersigned attorney of record, Keith M. Tackett, hereby declare as follows:

1. Attached is an invention alert (Exhibit A) dated prior to October 11, 2000, that my firm received prior to filing the present application. All masked dates in Exhibit A are prior to October 11, 2000. Confidential information not relevant to the invention date of the present application is also masked.
2. In view of Exhibit A, to the extent reference *Ashjaee, et al.* (US Patent Application Publication No. 2003/0029731) is relied on by the Examiner in the rejection of pending claim 24, the subject matter disclosed by *Ashjaee, et al.* was possessed by Applicant prior to October 11, 2000, and was included in the present application with due diligence from prior to October 11, 2000, to filing of the present patent application on September 21, 2001.
3. The undersigned, Keith M. Tackett, hereby declares that all statements made herein of his own knowledge are true and that these statements made on information

and belief are believed to be true and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent resulting therefrom.

4/20/04

Date



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Registration No. 32,008  
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Attorney for Applicant(s)

C.M.V.  
1399  
BH/RL

# INVENTION ALERT FORM

TO: Gaile Bailey  
Extension:  
Current Date:

M/S 2061  
32724

ALERT NO: \_\_\_\_\_

[DATE]

0005262

CIRCLE ONLY ONE FROM EACH TOP SECTION:

1) OWNER 2) DIVISION 3) PRODUCT BUSINESS GROUP(PBG)

PLEASE SUBMIT ONE ORIGINAL, SIGNED DOCUMENT FOR RECORDING. IF THIS IS A COPY OF A PREVIOUSLY SUBMITTED ALERT, PLEASE MARK IT ACCORDINGLY

| OWNER |        | AMAT    |      | AMT  |          | AMK |                   | AMSEA  |       | AMJ      |  |
|-------|--------|---------|------|------|----------|-----|-------------------|--------|-------|----------|--|
| TPI   | PDD    | ETCH    | ATD  | IBSS | CORE     | PRP | MD                | AKT    | PDC   | SOFTWARE |  |
| EPI   | KPU1   | METAL   | ATD  | IBSS | CORE TEC | PRP | COPPER            | ACVD   | OPAL  | AMIL     |  |
| ORION | KPU3   | SILICON | CORP |      | MICRO    |     | PLUG              | APVD   | ORBOT |          |  |
| OXDL  | KPU8   | HDP     |      |      | CORE ENG |     | LINER/<br>BARRIER | AETCH  | NPD   |          |  |
| AIT   | PSI    | MXP&RPS |      |      | PROCOMP  |     | BASELINE          | AHRDWR | ITC   |          |  |
| CAP   | CMP    | COM ENG |      |      | CORE KNO |     | ECD/CU            |        |       |          |  |
|       | LOWK   | HEXODE  |      |      |          |     |                   |        |       |          |  |
|       | HIGH K | SMO     |      |      |          |     |                   |        |       |          |  |

Please use separate attachments for any answers that don't fit on the form, especially for questions 3-8. If the answer to a question is "NONE", please write "NONE" rather than leaving the answer blank.

1. Title of Invention (please print clearly):

The Method of Electrochemical and Mechanical Planarized Plating (ECMPP) and

The Integration of Electrochemical Plating (ECP) with Copper Chemical Mechanical Polish (CMP)

2. Inventors-Names only-(please print clearly and provide complete information at Section 9)

Stan Tsai and Shijian Li

3. Earliest dates and model names of all Applied products incorporating the invention which have been offered for sale or are expected to be offered for sale:

N/A

4. If the invention has been demonstrated or described to persons other than Applied employees, for each disclosure please provide the earliest date, name of company, a brief description of what was disclosed and the purpose of the disclosure. Attach a copy of any related non-disclosure agreements:

None

COMPUTER ENTERED  
[DATE]

5. If future disclosures like those in Question #4 are expected to occur within the next 12 months, please provide the anticipated date, type of information to be disclosed, and purpose of the disclosure:

NONE [x]

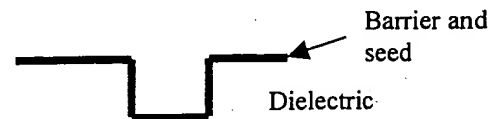
6. Describe any other known designs or processes, whether actually implemented or merely proposed in a publication, which could be considered similar to your invention or which constitute the state-of-the-art improved upon by your invention. If described in a publication, attach a copy of the same or provide a citation.

Unknown

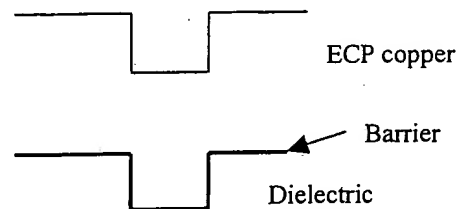
7. List each feature of the invention, which you consider novel and non-obvious. Describe the advantages of each novel feature in comparison with the state-of-the-art approaches, which are most similar to your invention:

For conventional copper metalization in semiconductor industry, after barrier and seed, copper is electrochemically plated (ECP) and then chemical-mechanically polished (CMP).

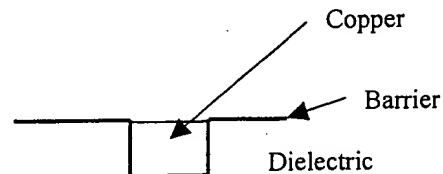
After barrier and seed



After ECP



After CMP (copper removal)



The process flow suffers a few fundamental disadvantages,

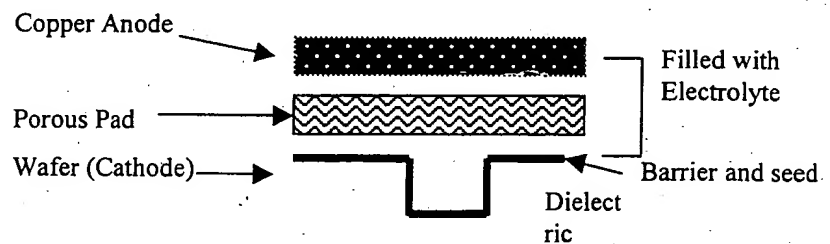
- a) The ECP copper is conformal to the topography of its substrate. The topography is sometime a technique challenge for CMP.
- b) To ensure a complete filling of copper and also to leave enough room for CMP topography correction, ECP copper film is usually very thick. The thickness adds significantly the consumable cost and reduces throughput for both ECP and CMP process.

- c) Since ECP and CMP are separated processes, to ensure the pre-CMP copper film quality, there are quite a few add-on steps post ECP (e.g., SRD, annealing, etc.). These steps again add COO to the entire copper metalization.

This invention integrates a planerization mechanism to the ECP process. The post ECMPP surface will have much reduced surface topography and thinner copper film. It is CMP friendly and readily prepares the two processes for module integration. The invention will drastically reduce COO for both ECP and CMP.

8. Describe the invention, preferably with reference to attached drawings:

This invention adds a planerization mechanism to the ECP process. Figure below shows an example, where mechanical abrasion is used as a mean of planerization.



The porous pad is pressed and has relative motion against the wafer surface. (Mechanical abrasion can come with variety of formats. And also, mechanical abrasion is not the only mean for planerization. The use of megasonic energy, for example, may also bring some desirable effects.)

The mechanical interaction between the pad and the wafer drastically reduces the thickness of the electrolyte film at the wafer surface and thus its diffusion layer. The diffusion layer is critical to the ECP performance. This change is much favorable to the plating process with greatly enhanced plating rate and the levelling effect. The later effect is desirable to the "bottom-up" fill of the small trenches (e.g. sub 0.1u).

The mechanical contact also directly blocks plating at the high points and thus reduces surface topography. It thus reduces the thickness of the copper film required to fill the gap for ECP and improves COO for both ECP and CMP.

This invention also directs an integration of ECP and CMP sequence module on the same platform, which is optional to the ECMPP process illustrated above. The sequence is, naturally,

Step-A: ECMPP to generate a thin copper film with low topography,

Step-B: CMP (preferably ECMP, Electrochemical Mechanical Polish) to remove the copper film.

Step-B shares the same platform as step-A, with possibly a different chemistry, pad and a reversed polarity of electrode potential.

9. Provide the following information for EACH inventor:

|                     |                      |
|---------------------|----------------------|
| <b>Inventor #1:</b> |                      |
| Name:               | Stan Tsai Employee # |
| Work Phone          |                      |
| Job Title:          | [ CONFIDENTIAL ]     |
| Citizenship         |                      |
| Home Address        |                      |
| Manager:            |                      |
| Div. Manager        |                      |
| Product Group:      |                      |

|                     |                       |
|---------------------|-----------------------|
| <b>Inventor #2:</b> |                       |
| Name:               | Shijian Li Employee # |
| Work Phone          |                       |
| Job Title:          | [ CONFIDENTIAL ]      |
| Citizenship         |                       |
| Home Address        |                       |
| Manager:            |                       |
| Div. Manager        |                       |
| Product Group:      |                       |

FOR ADDITIONAL INVENTORS, PLEASE COMPLETE AND ATTACH ADDITIONAL SHEET AS NEEDED.

10. Signature, date and **PRINTED** name of each inventor plus two witnesses who have read and understood this Invention Alert form:

**Inventors:**

Stan Tsai  
Printed Name

[DATE]

          
Date

                                                  
Signature

Shijian Li  
Printed Name

[DATE]

          
Date

                                                  
Signature

                                                  
Printed Name

          
Date

                                                  
Signature

                                                  
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